

THE MANUFACTURE AND USE OF BRICKS AT THE RALEIGH SETTLEMENT ON ROANOKE ISLAND

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Archaeological excavations in 1965 at Fort Raleigh National Historic Site on Roanoke Island contributed important information relative to the two questions: (1) Were brick and tile used by the Raleigh colonists? (2) If so, were they brought from England or made locally?

The Archivo General de Indias in Seville contains a deposition made under oath to the Spanish governor at Saint Augustine in 1600 by one "David Glavin, Irish soldier."¹ This was, in all probability, the Darby Glande listed as one of the members of the 1585 voyage, as was also the Darbie Glaven mentioned in John White's narrative of the 1587 voyage.² Glande's testimony dealt with his participation in the two colonizing ventures and provides information about the 1585 settlement not recorded elsewhere. One of the most intriguing of his claims has been translated as follows: "There, as soon as they had disembarked, they began to make brick and tiles for a fort and houses."³

Not all of Glande's deposition can be accepted at face value,⁴ but there seems to be no sound basis for questioning the alleged alacrity of the settlers in starting to make bricks and tiles. Even so, historians have been cautious about accepting this single bit of evidence, explicit and reliable as it appears to be. In referring to the above assertion by Glande, the historian David Quinn states: "This would

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¹ David Beers Quinn (ed.), *The Roanoke Voyages, 1584-1590: Documents to Illustrate the English Voyages to North America Under the Patent Granted to Walter Raleigh in 1584* (London: Hakluyt Society [Second Series, No. CIV], 2 volumes, 1955), II, 834-838, hereinafter cited as Quinn, *Roanoke Voyages*. The deposition is signed "David Glavid."

² Quinn, *Roanoke Voyages*, II, 519.

³ Quinn, *Roanoke Voyages*, II, 835.

⁴ Quinn, *Roanoke Voyages*, II, 519, 835.

suggest that at least some of the buildings of Roanoke Island had brick bases. . . ."⁵ In another place he writes: ". . . it is probable that brick was made during the 1585-6 settlement, but the evidence is not conclusive. . . ."⁶ Dr. Charles W. Porter III is a little more positive, writing that "The chimney and foundations [of the settlers' houses] were presumably of brick because the Irishman Darby Glante, later testified. . . ."⁷

Only one reference, other than Glante's deposition, gives any hint of how the colonists built their houses, and that tells only that the roofs of at least some of the buildings were thatched.⁸ Lacking more specific information, building practices of the period are the best, and only, source. Even this source must be considered in reference to several factors, such as the customary building practices of the colonists, size and intended permanency of the new structures, and available building materials. Thomas Hariot's *Briefe and true report of the new found land of Virginia*, although written primarily to recruit settlers, told of "divers sortes of trees," including oak, walnut, and "firre" [pine], suitable for "house and shiptimber."⁹ Even with an abundance of good timber, however, the colonists would have felt quite strongly the need for brick or stone for footings and fireplaces. Chimneys could be built of wattle-and-daub, but it would have been a difficult adjustment for an English builder of Raleigh's day to have laid wooden members directly on the ground.

Hariot noted the absence of suitable building stone in the vicinity of Roanoke Island, but until a source could be located he seemed confident that brick made from local clays was a feasible and acceptable substitute.¹⁰ The local clay appeared to be satisfactory for brickmaking, and there was no shortage of fuel to fire the kilns. The time required to make bricks would have been the main problem, since brickmaking could not be hurried without sacrifice to the quality of the product. If work had started on arrival of the colonists in August, as Glante stated, summer weather would have speeded up the operation, and it is conceivable that the first kiln could have been fired within a month. Normally, however, six months to a year would have been required.

⁵ Quinn, *Roanoke Voyages*, II, 835.

⁶ Quinn, *Roanoke Voyages*, I, 367.

⁷ Charles W. Porter III, "Fort Raleigh National Historic Site, North Carolina: Part of the Settlement Sites of Sir Walter Raleigh's Colonies of 1585-1586 and 1587," *North Carolina Historical Review*, XX (January, 1943), 29.

⁸ Quinn, *Roanoke Voyages*, I, 282.

⁹ Quinn, *Roanoke Voyages*, I, 363.

¹⁰ Quinn, *Roanoke Voyages*, I, 363.

Hariot also commented on the abundance of shells for making lime, referring to the use of shell lime in the “. . . Iles of Tenet and Shepy [in Kent], and also in divers other places in England: Which kinde of lime is well knowne to bee as good as any other.”¹¹

The colonists apparently set to work at once erecting permanent houses, most of which were probably one-room cottages with sleeping space in the loft. Of concern here is the type of construction as a clue to the extent to which bricks might have been used. Having familiar building materials at hand, one can assume that traditional construction methods were followed. A review of building practices in rural Elizabethan England, therefore, should provide the best guide for the basic methods used in the Raleigh colony. Reference as to how the houses were built in other early colonies, particularly at Jamestown, should also be helpful.

Post-and-truss construction was the common method of building small houses and cottages in England at the time of the Raleigh settlement. C. F. Innocent in his book *The Development of English Building Construction* states that “this kind of construction reached its height in the sixteenth century. The buildings then erected are of this kind wherever the necessary timber was obtainable. . . .”¹² It consisted of a rigid skeleton of timbers supporting a roof truss. The roofing material was commonly thatch, although tile and stone-slates were used in some sections. Usually the spaces between the wooden wall members were filled with interwoven withes or laths and plastered with clay mixed with straw, a method called “wattle-and-daub.” Post-and-truss frames with wall spaces filled with wattle-and-daub is commonly referred to as “half-timbered” construction.¹³ The first step in constructing a building of this type, and the one relating directly to the present discussion, was to build a low, continuous foundation of brick or stone. On this base was placed a heavy timber sill, into which upright posts were inserted at intervals.

Although the post-and-truss technique for framed structures was customary in England in 1585, the “cruck” method had not died out and must have been known to the Raleigh colonists.¹⁴ In fact, it

¹¹ Quinn, *Roanoke Voyages*, I, 367-368.

¹² C. F. Innocent, *The Development of English Building Construction* (Cambridge, England: Cambridge University Press, 1916), 75, hereinafter cited as Innocent, *English Building Construction*.

¹³ For detailed description of this method of construction, see Innocent, *English Building Construction*, 125-126, and Harry Batsford and Charles Fry, *The English Cottage* (London: B. T. Batsford, Ltd. [Third Edition, Revised], 1950), 24-38, hereinafter cited as Batsford and Fry, *The English Cottage*.

¹⁴ Batsford and Fry, *The English Cottage*, 25.

appears to have been used at Jamestown more than twenty years later.¹⁵ It refers to the method in which the basic framework was composed of curved or bent tree trunks, joined at the top and supporting a heavy ridge pole. This framing, which resembled a Gothic arch, carried the rafters and bracing, to which were attached the thatched roof and wattle-and-daub walls. But even if the Raleigh colonists had been inclined to use this outmoded method of construction, they would still have needed brick or stone for footings. By Tudor times, it was the practice to rest the slanting posts on low masonry walls, although in earlier times rough stone plinths were used.¹⁶

Other varieties of construction of that general period included various forms of palisaded walls (tree trunks or timbers placed upright in a trench)¹⁷ and a method sometimes used in the seventeenth century at Jamestown in which the wooden sills of a timber-framed building were supported on a series of posts sunk into the ground.¹⁸ This latter technique was practical when the first floor was elevated above the ground and ventilation desired below the floor. In addition to wall construction making use of wooden members, English cottages of that time also were built of stone, brick, and mud without supporting framework. The latter, still in use in parts of England, had various names, the most common being "cob." These methods were not likely to have been employed at Roanoke Island, and therefore are not relevant to the present discussion.

The typical English framed cottage of Elizabeth's day had only the bare ground for a floor, or more rarely a brick paving. One can assume that the former was the case at the Roanoke settlement, particularly in view of White's account of finding melons growing in the fort and houses when he returned in 1587.¹⁹

It is more difficult to say what the attitude would have been concerning the construction of fireplaces. The earlier rural cottages in England often had no fireplace or chimney, the fire being built directly on the dirt floor and the smoke seeping out through a special vent or elsewhere as best it could. The typical framed, wattle-and-daub, thatched cottage of Tudor England, however, had a large

¹⁵ Henry Chandlee Forman, *Jamestown and St. Mary's—Buried Cities of Romance* (Baltimore: Johns Hopkins Press, 1938), 30-34, hereinafter cited as Forman, *Jamestown and St. Mary's*.

¹⁶ Batsford and Fry, *The English Cottage*, 19.

¹⁷ Forman, *Jamestown and St. Mary's*, 30-31.

¹⁸ John L. Cotter, *Archaeological Excavations at Jamestown, Virginia* (Washington: National Park Service, U.S. Department of the Interior, Archeological Research Series Number Four, 1958), 60-61, 84, 129-131.

¹⁹ Quinn, *Roanoke Voyages*, II, 524.

fireplace, usually lined with brick or stone, with a huge wooden lintel. The chimney, too, would normally have been of brick or stone. An Englishman of that day, however, not having stone or brick at hand, would have been perfectly capable of building the fireplace and chimney of the same wattle-and-daub construction used for filling the spaces between the wall framing of his house. Or, if bricks were scarce, he would probably have used them for the fireplace and resorted to sticks and mud for the chimney.

Prior to recent archaeological discoveries, the possibility of the cottages having had tile roofs would have seemed almost too absurd to warrant discussion, even in the light of Glандe's testimony. In spite of the fire hazard of thatched roofs and laws requiring the substitution of tile or slate, thatch persisted as the most common roof covering in England for many years after the Roanoke voyages, particularly on smaller nonurban houses. Nearly a century later at Jamestown, thatched roofs were common, and laws calling for the use of tile or slate were still being ignored. One problem was the difficulty in making satisfactory tiles. As late as 1649 it was claimed that the local brickmakers did not know how to make tiles.²⁰ One would have to assume, therefore, that practical considerations, as well as building precedent and experience, would have dictated the use of thatch by the Raleigh colonists.

Of interest, too, is the fact that Hariot, in discussing building needs and resources in the new land, referred to stone, bricks, and lime, but made no mention of tiles. Then there is the inference of thatch on even the better houses in Lane's account of the Indian plot, in which he wrote that the Indians planned to "beset my house, and put fire in the reedes, that the same was covered with. . . ." ²¹ This documentary evidence supports the common-sense conclusion that Glандe could have been correct in respect to brickmaking, but certainly not on the matter of making tiles.

The foregoing information was known in 1947 when the National Park Service began archaeological explorations at Fort Raleigh National Historic Site. The possibility of bricks and tiles having been made and used by the colonists was not taken too seriously, and the prospect of finding a brick foundation, or even the remnants of a

²⁰ J. C. Harrington, "Seventeenth Century Brickmaking and Tilemaking at Jamestown, Virginia," *Virginia Magazine of History and Biography*, LXIII (January, 1950), 18, hereinafter cited as Harrington, "Brickmaking at Jamestown."

²¹ Quinn, *Roanoke Voyages*, I, 282.

fireplace, was considered unlikely.²² Archaeologists have a tendency to mistrust such uncorroborated evidence as Darby Glande's testimony. Nevertheless, a sharp watch was kept for fragments of brick or tile. Even if none of the test trenches crossed directly over a house site, it was considered likely that bricks from such a site would more likely be scattered and more readily found than other building refuse, such as mortar, nails, charcoal, and ashes.

During the earlier explorations in the Fort Raleigh area beginning in 1947, only six fragments of old bricks were found. By "old" is meant handmade, sand-struck bricks, rather than the later wire-cut type. Five of the six fragments are from conventional bricks; the sixth is from a thin "Dutch" brick and not of concern to the present study. Even with whole bricks it is impossible to determine more than the general period of their manufacture, while small fragments tell very little. One of the pieces from the earlier excavations is $2\frac{1}{4}$ inches thick, which conforms to brick of the Tudor period, and thus does not eliminate the possibility of its association with the settlement.²³ It was found at the same level and near one of the Indian campfires uncovered in the partially filled fort ditch. Another similar fragment was found in the fort ditch at a depth of 3 feet, but is too badly eroded to provide even an approximate measurement. It must have been picked up along the nearby shore, as it is quite clearly water worn. The other three fragments look old, but were found near the surface, which precludes any conclusion as to when they were deposited.

Only one fragment of roofing tile was found in all the archaeological excavating at Fort Raleigh prior to 1965. It came from the very bottom of the fort ditch and must have been dropped there soon after the fort was abandoned.²⁴ On the basis of this single fragment, its location notwithstanding, tilemaking by the colonists, or even the importation of tiles from England, could not be considered proven. Just as with the five brick fragments, it was highly suggestive, but needed corroboration, even when viewed in conjunction with Glande's statement.

The earlier explorations failed to locate the settlement site, and no further testing was undertaken until major construction was started

²² Jean Carl Harrington, *Search for the Cittie of Raleigh, Archeological Excavations at Fort Raleigh National Historic Site, North Carolina* (Washington: National Park Service, U.S. Department of the Interior, Archeological Research Series Number Six, 1962), 34, hereinafter cited as Harrington, *Cittie of Raleigh*.

²³ Harrington, *Cittie of Raleigh*, 23.

²⁴ Harrington, *Cittie of Raleigh*, 23.

in 1963. At that time, certain areas were checked by trenching with power equipment, both prior to and during construction of roads, parking areas, and buildings. Much of the area in the general vicinity of the fort was tested, but no additional archaeological work was carried out in the more likely section just west of the fort. Sand dunes and heavy vegetative cover make this location difficult to explore. In fact, even narrow trenches, if carried to the necessary depth, would injure the trees and seriously alter the terrain of this attractive part of the site. It has been accepted that the best chance of finding significant remains in this critical area would be by pure accident—possibly under a blown-down tree, in the eroding bank along the shore, or in a trench being dug for utility lines. The last is exactly what happened.

In 1959 a trench was being dug to carry power and water lines across the road to the restored fort. A foot below the pavement and about 35 feet from the outer edge of the fort ditch, the workmen encountered what they thought to be a brick floor. Work was stopped, the utility trench relocated, and the feature covered and marked for future investigation. Opportunity to check this discovery did not come until the spring of 1965. Excavation of the "brick floor" turned out to be much more of an undertaking than anticipated. A detailed archaeological report on the excavation of these remains has just been published.²⁵ The present article, therefore, will deal primarily with the implication of the discovery of bricks and tiles found in association with a sixteenth-century feature on Roanoke Island.

The feature referred to above has not been identified with certainty, but would appear to have had some military function, and may be related to the nearby earthen fort restored in 1950. A portion of it forms a nine-foot square, sunk one and a half feet below the original ground line. The "brick floor," accidentally uncovered in 1959, turned out to be a circular fire pit about two feet in diameter. Two other similar fire areas were found immediately adjacent to the first one, and all within the sunken square. They contained quantities of charcoal and ashes, but more interestingly, a number of bricks and brickbats. There were also a great many Indian pottery sherds, the neck of a ceramic bottle of European origin, and a few fragments of roofing tiles. This miscellaneous material was imbedded in clay, which had been hardened from the heat of the fires. It was not as

²⁵ Jean Carl Harrington, *An Outwork at Fort Raleigh: Further Archeological Excavations at Fort Raleigh National Historic Site, North Carolina* (Richmond: Eastern National Park and Monument Association, 1966).

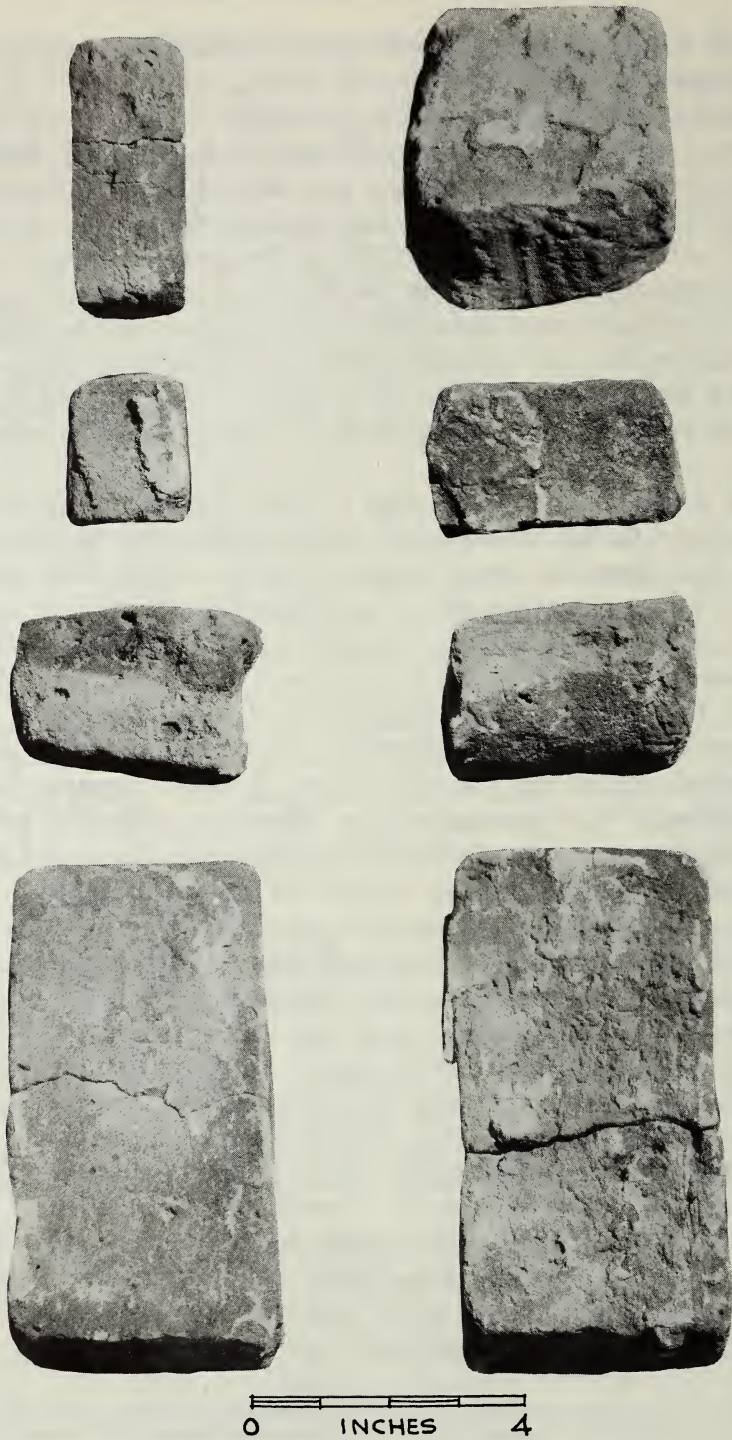


Figure 1. Examples of abraded bricks and two of the whole bricks. What appears to be remnants of mortar on some of the bricks is the clay in which they were embedded in the fire pits.

hard as the bricks, but sufficiently similar to explain the initial identification of the 1959 discovery as a brick floor. Laboratory tests showed this cementing material to be identical, physically and chemically, to the natural clayey sand lying below the humus zone in this locality.²⁶

One interpretation of these finds is that Indians used the structure after the colonists had left, just as they had the fort where they had built campfires in the partially filled fort ditch. No bricks were found in these hearths at the fort, but an earlier Indian campfire under the fort parapet contained fire-fractured stones, presumably used for supporting the typical pointed pottery vessels.²⁷

Indian origin of the firepits excavated in 1965 is also suggested by the large number of Indian pottery fragments found in and near the features. Several separate vessels are represented, many fragments having been imbedded in the cementing clay, along with bricks and brickbats. The concentration of Indian pottery in these small hearths, compared with its infrequent occurrence in other excavations nearby, points to rather extensive use of the abandoned structure by Indians. Another point in favor of the Indian theory is the complete absence of European objects in the charcoal and ashes outside the firepits, whereas broken Indian pottery was found scattered throughout the sunken structure. Whatever the origin of these hearths, the point of concern here is that someone salvaged the brick and tile fragments from a Colonial site, presumably nearby.

Except for six or seven whole, or restorable, bricks and a few sizable brickbats, most of the pieces of brick had been worn down intentionally on one or more surfaces. A few examples are shown in Figure 1. Most of the abraded faces are perfectly flat, obviously resulting from being rubbed against a flat surface, although the faces of some are rounded. Two specimens are most unusual, displaying concave surfaces (Figure 2).

Clearly these bricks had been used for other than construction purposes prior to being deposited in the hearths. One can only speculate on what this use had been. Possibly the concave specimens served for smoothing wooden objects, such as shafts for pikes, or handles for tools. The flat one might have been used for polishing armor or sharpening swords, axes, or other implements. It does not

²⁶ Sam H. Patterson, "Investigation of brick, tile, and 'mortar' and their possible raw materials from archeological excavations, Fort Raleigh, North Carolina," (unpublished report released in open files by the United States Geological Survey, September 20, 1965; copies available for consultation in the Geological Survey Library, Washington, D. C., and in the office of the superintendent, Cape Hatteras National Seashore, Manteo), 7, hereinafter cited as Patterson, USGS report.

²⁷ Harrington, *Cittie of Raleigh*, 40.



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Figure 2. Top and side views of the two concave specimens. The illustrations used in this article were supplied by the author.

seem likely that they were employed by housewives—Indian or white—for grinding corn or in other domestic pursuits. The flat surfaces and the small size of some of the specimens seem to preclude any such use. One specimen, for example, was abraded on all six sides until it was reduced to only $1\frac{1}{8}$ x $1\frac{3}{4}$ x $2\frac{1}{4}$ inches (smallest example in Figure 1).

Brick size is of interest, but not too helpful for dating purposes. Complete measurements can be secured on only four bricks but width and thickness are available on several fragments. The whole bricks are identical in size: $8\frac{1}{4}$ x $4\frac{1}{8}$ x $2\frac{3}{8}$ inches. Following are measurements on a total of seventeen specimens, including the four whole bricks:

Length		Width		Thickness	
Inches	Number	Inches	Number	Inches	Number
$8\frac{1}{4}$	4	$4\frac{1}{4}$	1	$2\frac{1}{4}$	5
		$4\frac{1}{8}$	10	$2\frac{1}{8}$	7
		4	5	2	3
		$3\frac{7}{8}$	1	$1\frac{7}{8}$	1
				$1\frac{3}{4}$	1

The range reflected in the above table is no greater than expected in bricks fired in the same kiln and formed in the same set of molds. Bricks found stacked in a kiln excavated at Jamestown varied by 1 inch in length, $\frac{5}{8}$ of an inch in width, and $\frac{1}{2}$ inch in thickness.²⁸ Such variation may be due to the character of the clay, extent of puddling and curing, and conditions of firing. In discussing bricks in sixteenth-century English buildings, Nathaniel Lloyd points out that in a single course any of the three dimensions may vary half an inch or more, which he attributes, in part, to lack of care in making the wooden molds.²⁹

Even so, the dimensions of the general run of brick of any given period fall within a relatively close range. Bricks in English buildings dating from 1550 to 1600 are generally 9 to $9\frac{1}{2}$ inches in length, 4 to $4\frac{1}{2}$ inches in width, and $2\frac{3}{8}$ to $2\frac{1}{2}$ inches in thickness. In his rather lengthy table of brick sizes for English buildings, Lloyd records none as small in all dimensions as the ones from Fort Raleigh.³⁰ Their counterparts are found, however, in some of the buildings in Virginia dating from the first half of the seventeenth century. Those in the church tower at Jamestown, for example, which date from about 1640, are $8\frac{3}{8}$ x $4\frac{1}{4}$ x $2\frac{3}{8}$. But the majority of seventeenth-century bricks

²⁸ Harrington, "Brickmaking at Jamestown," 35.

²⁹ Nathaniel Lloyd, *A History of English Brickwork* (London: H. G. Montgomery; New York: W. Helburn, 1925), 11-12, hereinafter cited as Lloyd, *English Brickwork*.

³⁰ Lloyd, *English Brickwork*, 89-100.

in the Virginia colony are closer to those in sixteenth-century English buildings.

The 1571 charter of the Tylers' and Bricklayers' Company established the regulation brick size at $9 \times 4\frac{1}{4} \times 2\frac{1}{4}$.³¹ The next attempt to provide uniformity in bricks was the 1625 proclamation, which set the size at $9 \times 4\frac{3}{8} \times 2\frac{1}{4}$.³² A casual glance at tabulations of brick sizes for buildings of that period in England suggests that these regulations were ignored, but actually the variation may have been due to technical factors and carelessness, and not to intentional flaunting of the law. It would be unsafe to draw any conclusion as to period of manufacture of the Fort Raleigh bricks from size alone. The sample is too small to be of real statistical value, and other considerations are of greater importance than size in determining the age and provenience of these bricks.

Although the Fort Raleigh bricks are relatively uniform in overall dimensions, they are more irregular individually than others the writer has observed from sixteenth- and seventeenth-century structures. For example, the thickness measured at opposite ends of a given brick may vary as much as half an inch. This could have been caused by improper treatment while drying, or by stacking the bricks in the kiln before they were cured adequately. Other evidences of hurrying the manufacturing process can be seen, such as large interior voids and pitted exterior surfaces. It is possible, of course, that we are dealing with discards, although some of the bricks in the group are quite uniform in shape and texture.

The tile fragments recovered from the 1965 excavations and the one found earlier in the fort ditch are typical of the flat, shingle tiles of the period. They were also called "pin tiles," derived from the method of attachment. Two holes near one end were punched in the tile while still in the mold. This sometimes resulted in a thin layer of clay completely or partially covering the bottom of the hole, which was easily punched out when a wooden pin was inserted. With short pins, or pegs, having been driven into the holes, the tiles were hung over laths, spaced at proper intervals across the rafters.

The tiles found at Fort Raleigh are especially hard and dense, and of uniform texture. They appear to be a better quality than many of the tiles found at Jamestown, particularly those known to have been made in the Virginia colony. Enough fragments were recovered to

³¹ Lloyd, *English Brickwork*, 12, 46.

³² Lloyd, *English Brickwork*, 12, 46-47.

account for about three whole tiles. They probably represent more than that number, however, since very few pieces could be joined. It is quite evident that these fragments were brought in a broken state to the area where they were excavated, and not as whole tiles. Overall size of the tiles cannot be determined, but they are consistently $\frac{1}{2}$ inch thick. This conforms with the majority of tiles found at Jamestown, although their thickness varies from $\frac{3}{8}$ to $\frac{5}{8}$ of an inch. Those from the kiln excavated at Jamestown are nearer $\frac{5}{8}$ inch, which was also the thickness prescribed in an earlier English statute.³³

The next matter to consider is where these brick and tile were made and how they got to the north end of Roanoke Island. Undoubtedly, the bricks were manufactured for normal construction purposes, presumably for foundations, fireplaces, and chimneys. It is hard to conceive of the colonists making bricks just for use as tool sharpeners or armor polishers. If we can trust Glande, it was also planned to use bricks in the fort construction, as well as the houses. We can be reasonably certain that this objective was never achieved, since the fort's excavation yielded only two brick fragments. This assumes, of course, that the restored earthwork is, in fact, Ralph Lane's "new fort."

If the bricks in question had been salvaged from a house ruin, some evidence of lime mortar might have been left on the whole bricks and the several brickbats that had not been reused as abraders. However, this is not the case. What at first appeared to be a thin layer of mortar on some of the bricks, was later determined to be the fire-hardened clay in which the bricks, tile, and other refuse were imbedded in the hearths. In any event, it could not be mortar from laid bricks, since it occurs on the abraded surfaces of some of the smallest specimens.

It is difficult to see how, or when, the colonists could have salvaged bricks from a structure. Assuming Glande's testimony was correct and the colonists actually made bricks and used them in their first houses, these buildings would not have been in such ruinous condition that bricks would have been salvaged from them, even by the settlers who came two years later. We know that when the second group arrived in 1587 they found the houses still standing, and that they set about to repair them.³⁴ The evidence, therefore, is fairly strong that the bricks in question were never used in the construction of a building. This does not mean, however, that the colonists

³³ Harrington, "Brickmaking at Jamestown," 37.

³⁴ Quinn, *Roanoke Voyages*, II, 524.

did not use bricks in their houses; only that these particular bricks were not so used.

The second major question is whether bricks were actually made by the colonists, as claimed by Darby Glante. Laboratory tests helped in this instance. Samples of sub-surface clay, which is actually a clayey sand, were tested by the United States Geological Survey, as were also several of the brick fragments, as well as samples of the hardened clay from the hearths. The following is quoted from the report on these tests:

The archeological specimens and clayey sands were investigated by several methods. All samples and specimens were examined by a binocular microscope. . . . Test pieces of the "local clay" were made and fired along with chips of brick fragments. The mineralogy of a "local clay" and several archeological specimens was determined by optical and X-ray methods.³⁵

Technical details of the laboratory tests need not be included here; conclusions as to the probable origin of the bricks will suffice.

The mineral content of all the archeological specimens from Fort Raleigh, North Carolina, except the tile, is virtually the same as that of clayey sand, referred to in the sample descriptions submitted as "local clay"; and the brick fragments and "local clay" have essentially identical physical properties when fired. The conclusion that all the Fort Raleigh specimens, except the tile, were made from local materials, therefore, is reasonably certain.³⁶

Accepting this evidence that bricks were made locally, one can properly ask if they necessarily were made by the Raleigh colonists. The natural response to this question is, "If not by the colonists, who else?" Although two parties were sent from Jamestown in the seventeenth century to look for the settlement, and Lawson visited the site in 1701,³⁷ there is no evidence that any attempt by Europeans again to settle on Roanoke Island was made until the early eighteenth century. Even that was unsuccessful. The Outer Banks did not benefit immediately from new legislation and other stimuli to the establishment of towns in the Carolina colony. In fact, a century passed before there were more than a few isolated land owners living on the island. Land records covering property in the general vicinity of the fort can be traced back only to 1803.³⁸ It is not known when Indians last

³⁵ Patterson, USGS report, 3.

³⁶ Patterson, USGS report, 8.

³⁷ Frances Latham Harriss (ed.), *Lawson's History of North Carolina* (Richmond: Garrett and Massie, Second Edition, 1952), 61.

³⁸ Harrington, *Cittie of Raleigh*, 48.

lived or hunted on Roanoke Island, but they almost certainly were not building campfires in the fort ditch or in any remnant of the original settlement by the time there was sufficient white population to have started the manufacture of brick.

The tests made by the Geological Survey show that the bricks were not fired to a temperature above 1,575° F., since the chemical illite, which is destroyed at about this temperature, is still present. The report concludes that these bricks are so weak and friable "it seems improbable that such poor brick would have been shipped from Europe. . . ." ³⁹ Brick kilns, however, do not yield uniformly good bricks, and it is conceivable that the first hurried attempt to make bricks in 1585 was not overly efficient. The better bricks might have been used for construction, while the underfired, softer ones were thrown out. Could not these discards have been the ones subsequently used for a purpose other than construction?

Laboratory analysis helps here, too. Test pieces made from the local clay and fired to 2,000° F. showed the same physical characteristics as the bricks. So even the best specimens from the kiln would not have been good bricks. This does not mean that the colonists would have refused to use the results of their brickmaking efforts for construction purposes. It might be hazardous to build a wall with such poor bricks, but it is doubtful if that would have deterred a desperate and determined settler from putting them in house footings and fireplaces. It is possible, however, that the poor results of the first effort discouraged further attempts at brickmaking and that relatively few were ever made. After the initial effort, it must have been apparent to an experienced brickmaker that Hariot's appraisal of the native resources was inaccurate in respect to the clay being "excellent good" for bricks.

Archaeology and modern laboratory technology have thus joined hands in the vindication of Darby Glande—at least in respect to one of his allegations. But what about tilemaking, which Glande also claimed was started as soon as the settlers landed?

Unlike bricks, laboratory tests show quite clearly that the tiles found in the excavations were not made locally. The report on these tests reads in part as follows:

The tile fragments . . . , as observed under the microscope, contain much more fine-grained material and are appreciably redder than either the other archeological specimens or the fired "local clay." . . . That the tile could not have been made from a raw material such as "local clay"

³⁹ Patterson, USGS report, 8.

sample 2 is indicated by the abundance of fine-grained material and the presence of hematite which is not abundant in the "local clay" or in the test pieces fired at high temperatures. Also, chips of the tile fired at 2,000°F are much harder, more dense, and redder than the "local clay" fired at the same temperature.⁴⁰

Not only were the tiles in question not made from the same material as the bricks, but usable tiles could not possibly have been made from this earth.

The above results do not, by themselves, rule out local manufacture, since earth of the type used in the tiles may occur elsewhere in eastern North Carolina. It seems highly unlikely, however, that the colonists would have brought in material for tiles at the same time that they were making bricks from local clay. There is an additional argument in support of this deduction. These were well-made tiles and must have been produced in an established plant, rather than in a makeshift operation suggested by the poorly made bricks. The only reasonable conclusion, therefore, is that they arrived by ship from Europe.

The association of the tile with the bricks in the firepits, and the presence of a tile fragment of identical thickness and appearance at the bottom of the fort ditch, make it reasonably certain that the tile is of the same period as the brick. This type of tile would have no practical use except to cover a building, and it does not seem likely that fewer than enough to roof at least one cottage would have been brought to the colony. This would mean that as many as 2,000 tiles, as well as possibly a kiln-load of bricks, are waiting to be discovered by some future archaeologist.

Since Lane himself lived in a thatched cottage, what could have been the intended use of roofing tiles? Perhaps it was planned to roof the chapel with something more fitting, which suggests the possibility that the tiles were associated with the second venture of 1587, when colonizing plans were on a more permanent basis.

Evidence for the kiln having been in the general vicinity of the fort, although not conclusive, is suggested by the results of the laboratory testing. A second sample of earth, which superficially resembled the one from the archaeological trench, was secured half a mile west of the fort. Tests showed it to be "much lower in silt and clay, and when wet probably would not develop sufficient plasticity to be workable."⁴¹ Although only suggestive at this point, these results

⁴⁰ Patterson, USGS report, 6.

⁴¹ Patterson, USGS report, 3.

present a possible approach for narrowing down the general area for further exploration in search of the settlement site.

On the basis of present knowledge, the following conclusions seem valid: Although bricks were made by the Raleigh colonists, the results were not too satisfactory, and there is no evidence that the bricks were used for construction purposes. The location of the brickyard and kiln is not known but was probably not far from the site of the restored fort. The colonists were in possession of roofing tiles, which presumably were brought from England. There is no evidence that the colonists attempted to make roofing tile or that tiles were used on a structure at the Raleigh settlement. The new evidence does not add any clue to the settlement's location, although the possibility of its being in the vicinity of the fort is enhanced. In addition to limiting the area of search for the settlement site, there is a greater possibility than previously thought that durable construction remains may be found. And even if bricks and tiles were never incorporated into a structure, it is reasonable to assume that there exists a concentration of these materials.